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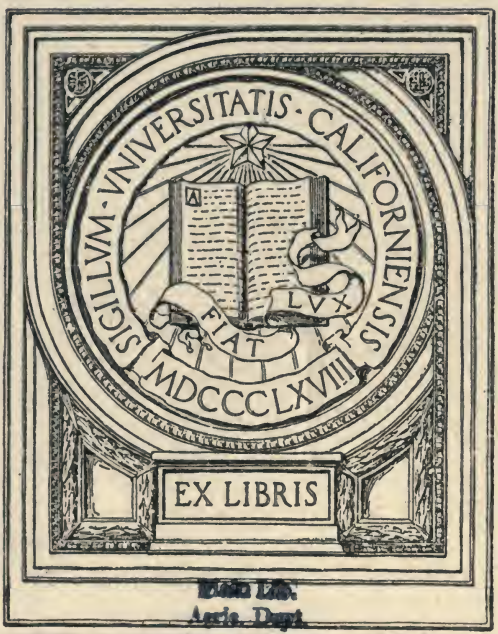

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CIRCULAR No. 1.

United States Department of Agriculture.

DIVISION OF CHEMISTRY.

THE MANUFACTURE OF SORGHUM SIRUP.

With each recurring season numerous inquiries are addressed to the Department relating to the manufacture of sorghum sirup. This circular is published to answer such inquiries in a more satisfactory form than can be done in an ordinary letter.

The production of a sirup or molasses of good quality, free from many of the objectionable features of this product as ordinarily made, requires a considerable degree of skill on the part of the workmen. Such high-grade product can not be manufactured by the haphazard methods in vogue in many localities.

In manufacture, the term "molasses" implies that the sirup resulting from the evaporation of the juice of the plant employed, has been concentrated sufficiently to cause a part of the sugar to crystallize. This sugar is removed either by drainage or by means of a centrifugal machine. The famous open-kettle molasses of Louisiana is usually separated by drainage. From these statements it may be seen that the sorghum product so often called "molasses" should be termed "sirup." This is a distinction of some importance, since if adhered to and superior products be manufactured, sorghum sirup should gain more than local fame and be regularly listed as a standard article for the grocery trade.

Experiments in the manufacture of a high-grade sorghum sirup have been made by this Department, under the direction of Mr. A. A. Denton, of Sterling, Kans., and the following method has been adopted by him as capable of producing the best results:

The cold juice, as it comes from the mill, is treated with sufficient cream of lime to render it slightly alkaline. Blue and red litmus papers, which can be procured from dealers in chemicals or from druggists, are employed in making the tests for alkalinity and acidity. The blue paper is reddened by an acid juice and the red paper is blued by an alkaline solution. If no red paper is at hand it may be prepared by dipping the blue paper in unlimed juice. If sufficient lime has been added, the precipitate formed will settle to the bottom of the tank, leaving the liquid clear and bright. A test sample should be examined in a narrow white glass bottle, or in a test tube, in order to note the effect of the lime. A little experience gained by

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a few trials will enable one to judge with reasonable certainty the quantity of lime required. A considerable excess of lime will increase the expense of manufacture in the subsequent stages without corresponding advantage.

The addition of clay is recommended to facilitate the settling of the impurities. Coarse-grained clays are not suitable for this purpose since they subside rapidly without carrying down the impurities. With very fine clays, however, the particles subside slowly. The sediment is easily disturbed in drawing off the clear liquid and turbid juices result. To be suitable for sirup manufacture the clay should contain no water-soluble matter. In general it has been observed that fire clays are usually too coarse grained, the pure white clays too fine, blue clays, gumbo, or waxy clays are not suitable, and that yellow or brown clays are best. The clay is added to the juice in the form of a smooth, thin batter. Experiments on a small scale, using small round bottles to permit observations of the progress of the precipitation, will soon give one the necessary experience. For the sake of economy as little lime and clay should be used as is consistent with good work.

The clear juice should be carefully drawn off from the lime and clay precipitate, when the latter has thoroughly settled. Heat the clear juice nearly to the boiling point, then sufficient superphosphate of lime* should be added to render it distinctly acid. This point is determined by the use of blue litmus paper, which turns red in an acid solution.

A distinct change in the paper from blue should be considered an indication of sufficient superphosphate. About one gallon of superphosphate of lime (concentrated) is sufficient for from 400 to 500 gallons of juice, the amount depending largely on the excess of lime employed. Use the superphosphate with care, since too great an excess will result in a sirup of disagreeable taste. After permitting the precipitate formed in the above process to settle, draw off the clear juice and rapidly concentrate it in a suitable evaporator.

The sediment from the treatment with lime and clay and that formed by the addition of the superphosphate should be mixed, a quantity of water added, and the whole thoroughly agitated. Settle and decant as before. The clear liquid should be added to the fresh juices coming from the mill and the sediment rejected.

It should always be noted in the manufacture of sirup, as well as in the production of sugar, that bright, brilliant, clarified juices are essential to success.

After the sirup has been evaporated to a suitable density it should be rapidly cooled. It should not be barreled until it reaches the ordinary temperature of the air. Before beginning the season's work a sufficient quantity of clay should be dried and ground in a mill.

The following procedure is recommended for manufacture without the use of clay:

As soon as the juice is expressed it should be treated with cream of lime. It is a good plan to slake the lime, then thin it with a considerable excess of water. This additional water permits the resulting milk of lime to be thoroughly strained for the removal of lumps and unslaked portions. A sieve with $\frac{1}{8}$-inch mesh is recommended. After straining, the milk of lime should remain at rest a few hours and part of the water which collects on the surface should then be removed.

In treating the juice care must be taken to avoid excess of lime. The juice should be limed to neutrality—that is, until neither the blue nor red litmus test paper changes color when immersed in it. Many prefer to leave it slightly acid. For making a light-colored sirup this is the preferable method; or the juice may be limed till slightly alkaline, and after clarification superphosphate of lime may be added as described in connection with the process employing clay.

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*Superphosphate of lime for use in sugar making is a regular article of commerce. It is an entirely different article from the superphosphate used as a fertilizer. For dealers' names, consult the advertising columns of the Louisiana Planter or the Sugar Bowl and Farm Journal, both New Orleans, La., publications.

After the addition of the lime the juice should be slowly heated to the boiling point. It should not be boiled at this stage. The heat should be continued until the blanket of scum shows signs of breaking in several places. The heating should then be discontinued and the blanket of scum be removed by a suitable skimmer. The juice should now be boiled briskly, the scum being brushed off as fast as it rises to the surface. It is well to examine a test sample of the juice in a small bottle after brushing. The particles of suspended flocculent matter should move rapidly; those near the sides of the bottle rising nearly to the surface and descending at the central part forming a cone-shaped deposit. The juice between these particles should be bright and of an amber color.

To obtain the conditions described above requires skill and patience, but it must be remembered that a bright sirup of good flavor can be made only from bright, well clarified juice. An excellent sirup may be made by adding a little bisulphite of lime in the above process. This bisulphite is made by passing the fumes of burning sulphur, to saturation, into cream of lime.

Returning to the clarification—after the juice has been boiled and thoroughly brushed, the heat should be withdrawn and the suspended matter permitted to settle. After settling as long as necessary, usually from one to two hours, the clear juice should be drawn off and evaporated very rapidly to a sirup. The skimmings should be settled and the clear juice decanted. The residue should be treated with water, settled, and the diluted juice drawn off. The drainings from the skimmings should be added to the fresh juice from the mill.

Some form of continuous evaporator based on the old-fashioned apparatus of Cook is best adapted to sorghum work. The juice constantly runs in at one end of the evaporator, passes back and forth across it, and finally the finished sirup runs out at the other end. The evaporation should be as rapid as possible. The sirup should be cooled rapidly.

If the sirup shows a tendency to granulate, the cane should be cut three or four days before it is to be worked and allowed to lie in the fields. If there is no tendency to granulation the cane should be worked immediately after harvesting.

A fairly good article of sirup can be made without the use of lime. Sirup made in this way always retains much of the rank flavor of the sorghum. It is exceptionally good, however, for baking purposes.

Sorghum sirup is made in every State of the Union and on thousands of small mills. When carefully made it is wholesome and palatable. Unless the utmost care and cleanliness are exercised by the maker, there is no process which will produce a good article, attractive to the consumer. If, however, the above principles are observed, care, attention, and experience on the part of the maker will give a good article of sirup, suited for use on the table and in the kitchen.

G. L. SPENCER,
First Assistant Chemist.

Approved:
CHAS. W. DABNEY, JR.,
Assistant Secretary.
WASHINGTON, D. C., *July 15, 1894.*

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